



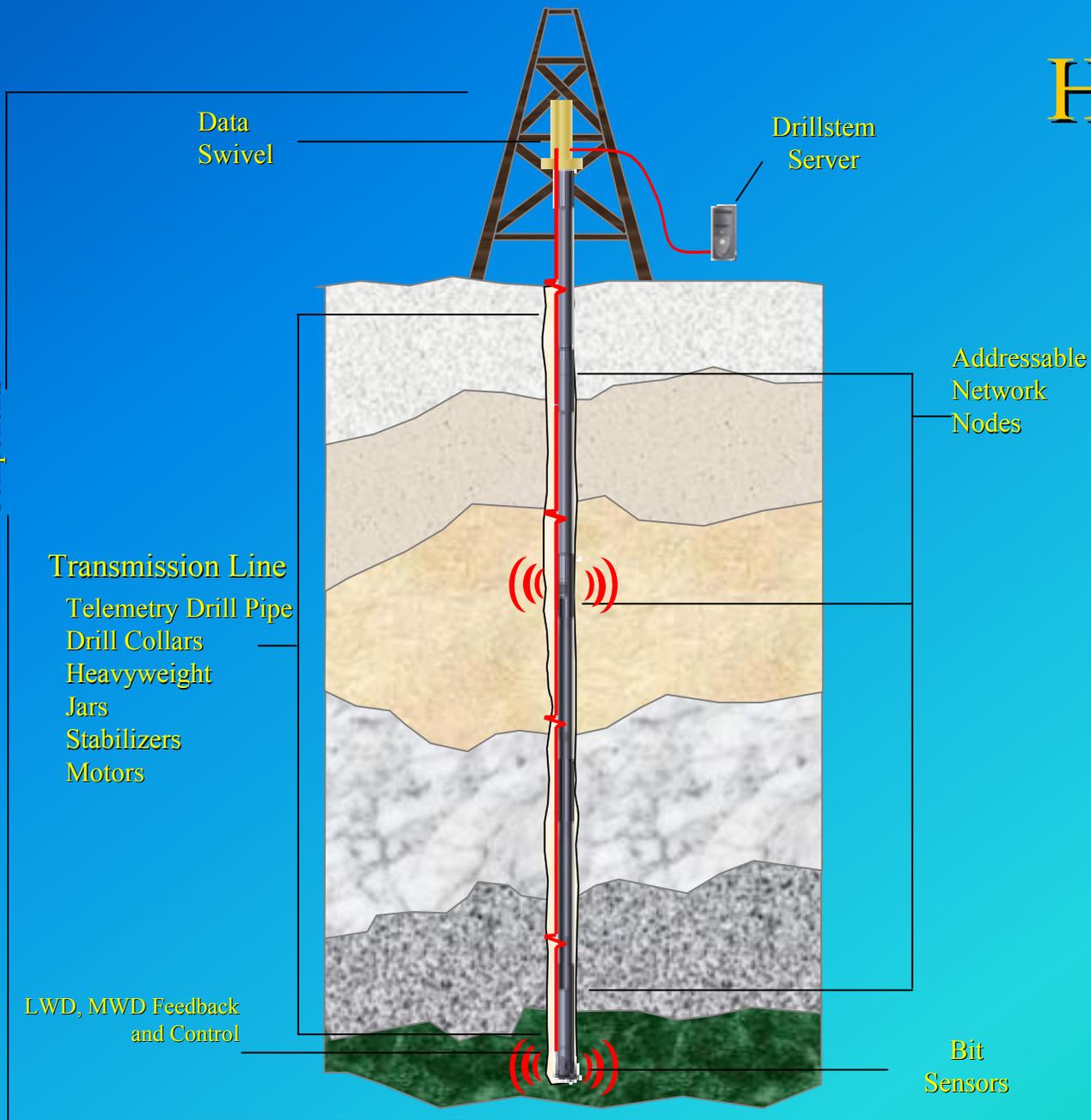
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Very High-Speed Drill String Communications Network

Rocky Mountain E&P
Technology Transfer Workshop
August 4, 2003

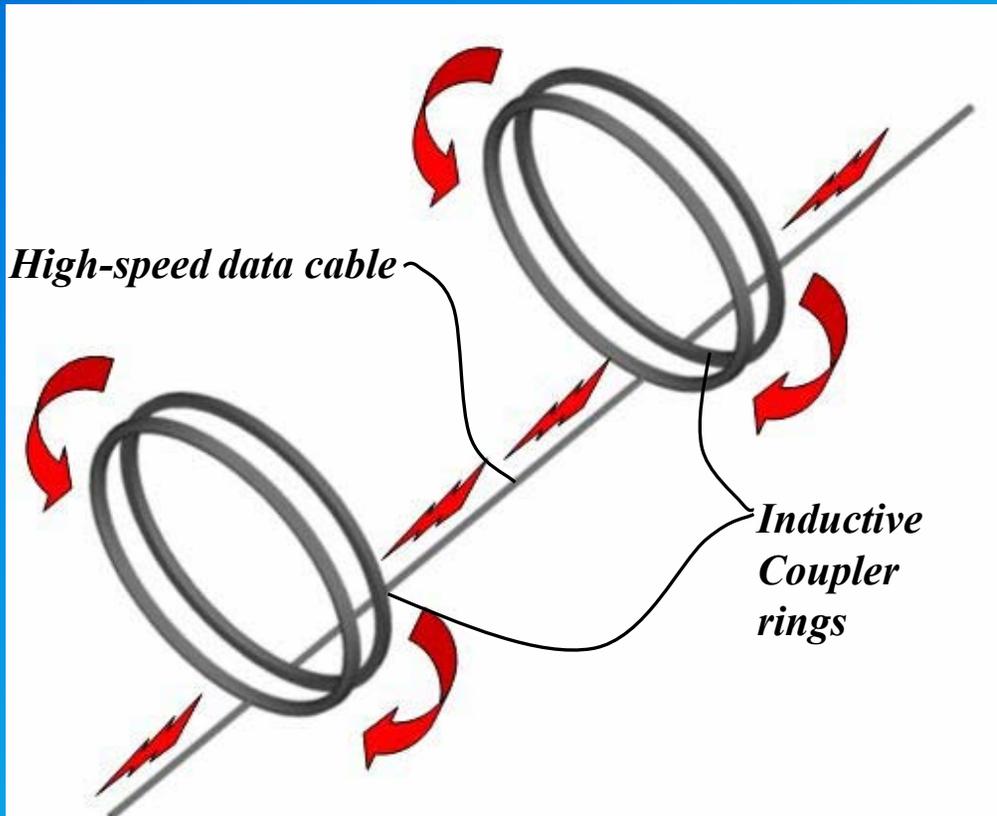
High-speed Drilling Network

Intelligent Components



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Basic Technology

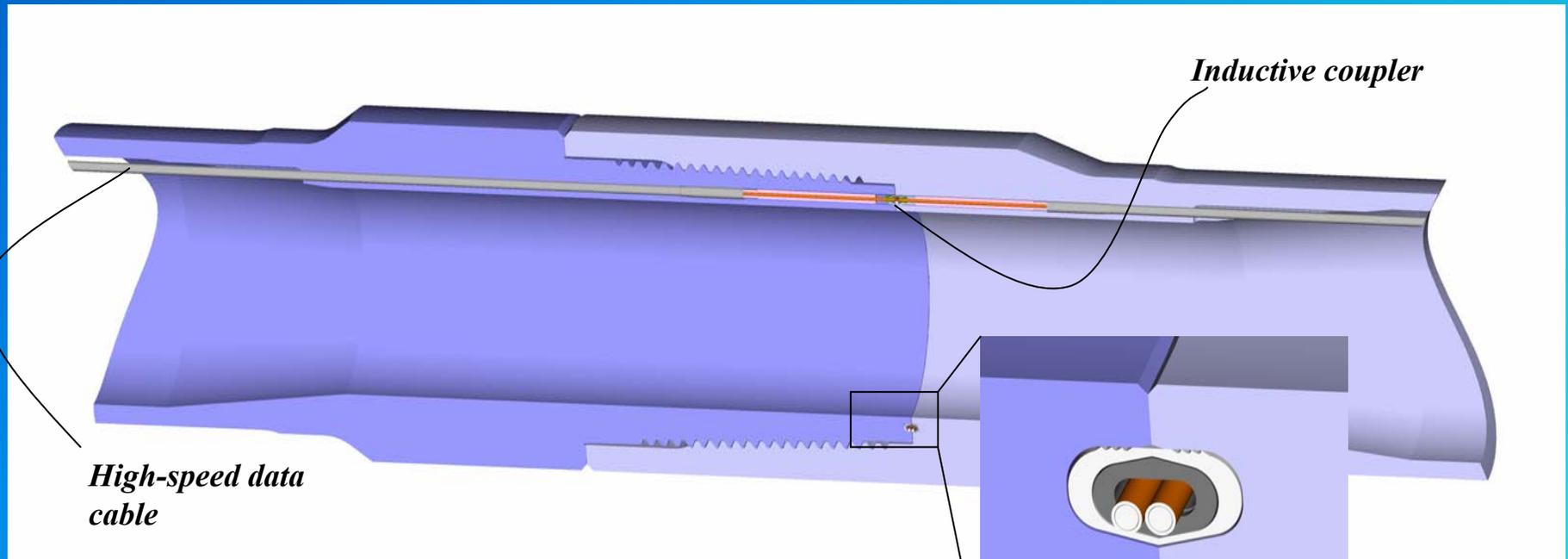


- Data cable optimized for high data rate
- Coupler uses induction (non-contact) :
 - Current flowing through one coupler ring produces an EM field that induces current flow in the adjacent ring



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Tool Joint Configuration

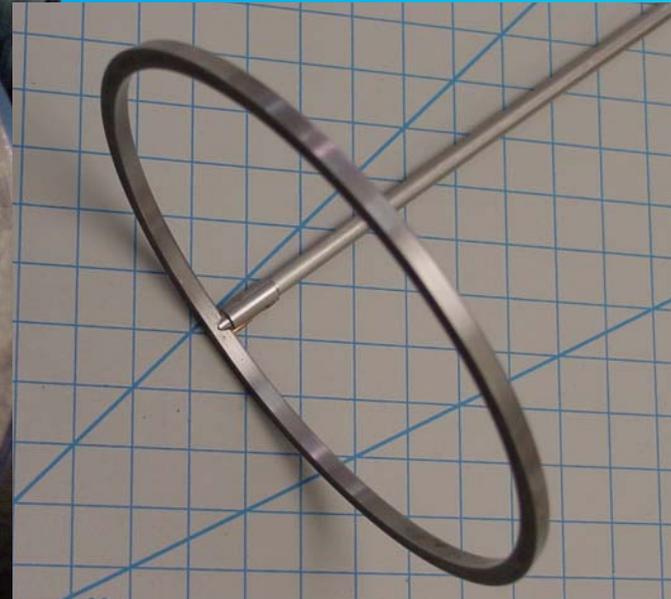
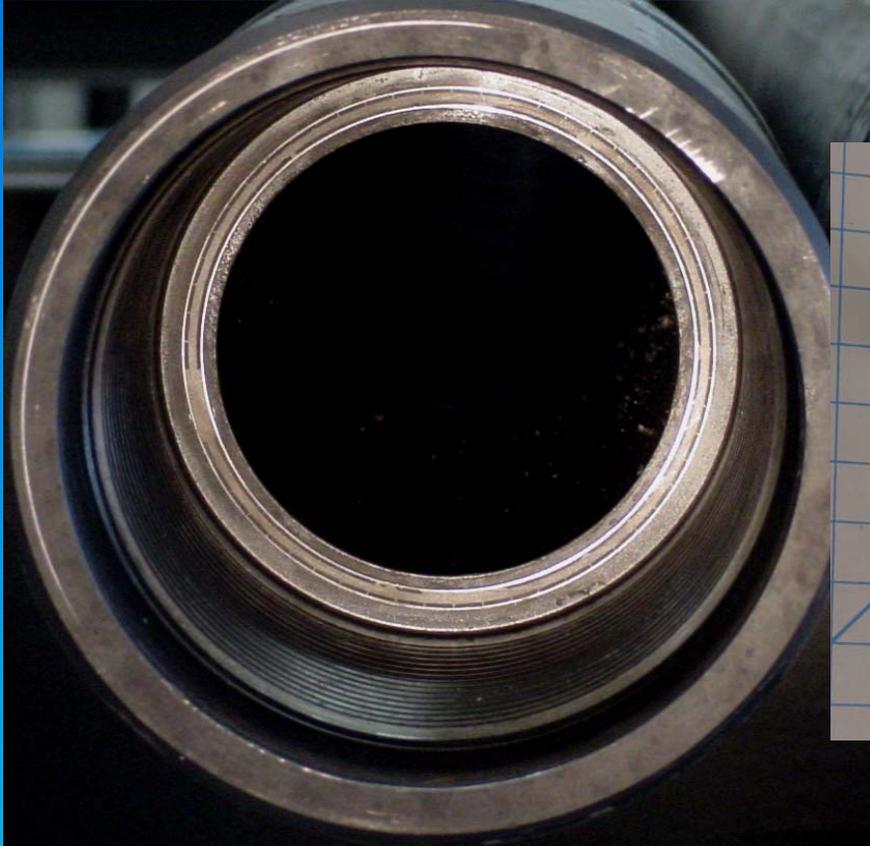


- ✚ Coupler rings are installed in the pin nose and corresponding box shoulder.
- ✚ Coils are inside a trough of focusing material that is electrically insulating but highly permeable magnetically to capture the inductive signal.



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Inductive Coupler Ring in Grant Prideco 5-7/8" XT57 Joint



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Telemetry Drill Pipe System Features

- High speed data cable is protected in the pipe and does not interfere with mudflow
- Double shouldered tool joint connection protects inductive couplers between mating sections and also brings couplers into close proximity
- “Milli-hop” coupling requires low power, transmits without substantial attenuation

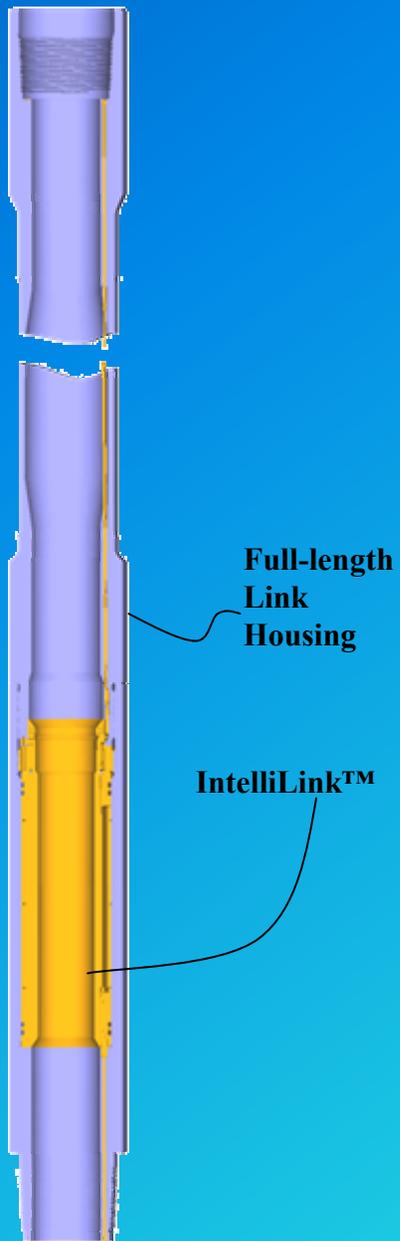


Range of Transmission

- ✚ High data rate requires amplification of signal periodically along the string
- ✚ Signal amplification by a powered, full-length joint inserted into the string at 1,000 to 2,000 ft intervals
- ✚ Data collection can occur anywhere along the string, at any amplification joint (“IntelliLink™”)



IntelliLink™



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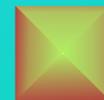
Operation

- ✚ No special handling or make-up procedures are required.
- ✚ Communication with the stationary world occurs thru a rotating top drive sub



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Rotating Top Drive Sub



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Pipe Sizes

🚧 5-7/8” XT57 eXtreme® Torque pipe

- Offshore, ERD applications

- NWDP, HWDP

🚧 5” GPDS50 pipe

- Runs like NC50 pipe

- Has double shoulder for higher torque capacity

🚧 Anticipate 3-1/2” DP next year



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5-7/8" 23.40# (0.361" wall) S-135 Drill Pipe System

- XT57 Tool Joint (7" OD x 4-1/4" ID)
- Tool Joint Torsional Strength - 94,300 ft-lb
- Tool Joint Working Torque - 56,600 ft-lb
- Pipe Body Performance Ratings:

	New	Premium
Torsion (ft-lb)	105,500	83,000
Tension (lbf)	844,200	666,500
Burst (psi)	14,520	13,610
Collapse (psi)	10,830	6,200



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Status



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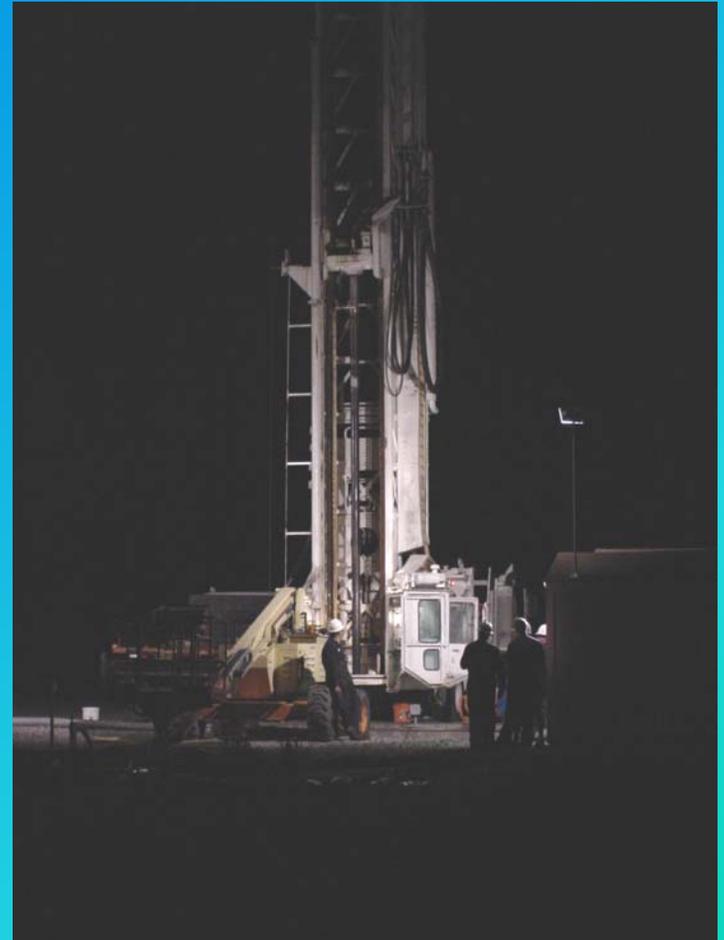
Full-scale Tests

Laboratory

-  Make and break
-  Mechanical fatigue
-  HP/HT chamber (small scale)

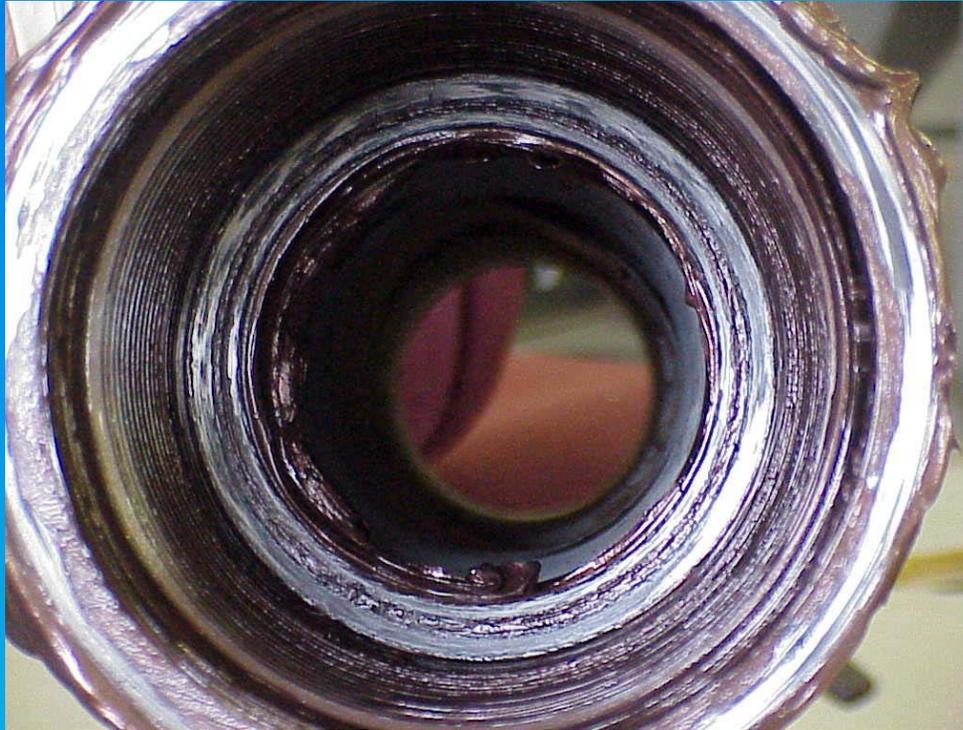
Novatek rig (1,000 ft well)

-  Flow and rotation
-  High differential pressure
(15,000 psi)
-  Vibration



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Rugged and Durable



The pipe used in tests has shown to be very durable. The above picture is of a tool joint and connection after over 70 Make-up/Break-out cycles. The conductivity of the connection remained robust.



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Field Test RMOTC



- ✚ 121 joints of IntelliPipe, Links, Heavyweight
- ✚ Network of 5 Smart Links
 - Successful bi-directional data transmission including live drilling data
 - 2 Mbit/sec transmission speed
- ✚ Pipe subjected to “normal” rig handling conditions
- ✚ TD of well 4531 ft including BHA



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Scheduled Testing

- ✚ Further durability testing – Q3/Q4 '03
- ✚ Application demonstrations (shallow wells)
 - Aug-Dec
 - MWD, PWD, Bit dynamics
- ✚ Field testing 8,000 ft string – Sept/Oct
- ✚ Field testing 16,000 ft string – Nov/Dec



Development - Focus Areas

- Top-to-bottom string
 - Collars, Jar, Stabilizers, Subs
- Application interfaces
 - Conventional: LWD, MWD
 - New: Seismic
- HP/HT
 - 200C/25ksi transmission line components
 - High temperature electronics modules



Applications/Benefits



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Telemetry Drill Pipe Capabilities vs. Current Technology

Mud Pulse Telemetry

- Approx 8 bits/sec
- Primarily bottom up communication with limited two-way capability
- Data from bottom of the drill string – only

Telemetry Drill Pipe System

- 1,000,000 bits/sec
(125,000 times faster)
- Bi-directional
- Distributed network



Benefits

- Real Time Data & Control
- Copious Data
- New Data Sources
- Improves
 - Reservoir characterization
 - Well completion/productivity
 - Drilling efficiency & safety



Improved Asset Value

Improved reservoir evaluation

-  Enables “real-time” seismic while drilling

Yields

-  Optimized well placement
-  Accelerated prove up process/production curve
-  Enhanced identification of secondary pay zones



Improved Well Productivity

- More and timelier position feedback
 - Precise entry into producing formations
 - Decrease overshoot
- Timely and more accurate formation information
 - Enables timely/advanced detection of the pay zone
 - Operators can alter fluid properties in timely manner (even before pay zone is reached)
- Less formation damage with UBD



Improved Drilling Efficiency & Safety

- ✚ Improved bit life with timely bit dynamic info - reduces drill pipe trips to replace worn bits
- ✚ Optimized casing point selection
- ✚ Enhanced well control
- ✚ Eliminate nonproductive survey time to retrieve data
- ✚ Permit increased use of Underbalanced Drilling (UBD)
- ✚ Monitor drill string wear and vibration to reduce drill string failures



Conclusion

- Development of a reliable, rugged telemetry drill pipe system is nearly completed.
- System offers transmission rates that are orders of magnitude beyond rates currently available from mud pulse and EM telemetry.
- Two-way or bi-directional communication is possible.
- The downhole drilling network can improve drilling efficiency, enhance well safety and lower overall well costs.
- Network can also improve well productivity and enhance reservoir characterization leading to optimized field development.
- The system should encourage further MWD/LWD and related innovations.



Q&A



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